

and High Bridge, Ky., but flood stages were not reached in the upper part of the river. The Big Miami was in flood below Hamilton, Ohio; the Whitewater and Little Miami were in flood, but flood stages were not reached in the Big Sandy Valley.

OHIO RIVER AND TRIBUTARIES FROM MOUTH OF THE KENTUCKY TO AND INCLUDING HAWESVILLE, KY.

By J. L. KENDALL

The flood developed in three parts or phases. The first was caused by the rains of the 9th to 15th, and crested at Louisville, Ky., on the 17th with a stage of 30 feet, upper gage, and 59 feet, lower gage.

Rain began to fall on this crest on the 17th and continued almost daily until the 23d, producing the second phase of the flood. During this period amounts of precipitation at representative stations were as follows: Louisville, Ky., 9.13 inches; Madison, Ind., 8.35 inches; Frankfort, Ky., 8.88 inches; High Bridge, Ky., 7.53 inches; Dam No. 43, Evans Landing, Ind., 8.91 inches; Dam No. 44, Leavenworth, Ind., 11.40 inches; Dam No. 45, Addison, Ky., 10.15 inches. This section of the flood rainfall ended with a freeze that held back about 0.60 inch of water in the form of snow and sleet. During this phase the flood passed the previous high watermark of February 15, 1884, 46.7 feet, and entered a new region for which there were no comparisons and no experience whatever. The historic record was passed by the rapidly rising stream at 12:30 p. m., January 22. At that time the river was rising at the rate of two-tenths foot per hour.

A crest near 52 feet, upper gage at Louisville, had been forecasted, and the flood showed indications of ending around that stage, when it entered its third phase with the heavy rain of Sunday, January 24. This rain fell on the accumulation of snow and ice, which acted much like a house roof in hastening its progress toward the river. Also, the water held back by the snow and sleet ran into the river with the rain, augmenting its effect. This rain, ranging from 2.00 to 4.00 inches in this district and falling with a high intensity, carried the river to its final crest of 72.7 feet at Madison, Ind., on the 26th, and 57.1 feet, upper gage at Louisville, on the 27th. The lower gage at Louisville was submerged at about 80 feet.

Aside from the entrance of this flood into 10 feet of altitude for which there is no comparison in the records, it had other peculiarities. The precipitation, while not continuous, was so closely grouped that no crest appeared nearer than the extreme upper river after the crest of 30 feet at Louisville on the 17th. This crest did not reach the lower river, where the rise was continuous. Because the heaviest rainfall occurred near the stream, the river filled rapidly from the sides, much like a ditch. Therefore, the flood became, to a marked degree, a rise in which the expected increase had to be computed directly from run-off, with less than the usual reference to gage relations. As with floods of this type, in about 48 hours after the rain ceased the crest was reached.

Another important feature was the tremendous output of the Kentucky River, which exaggerated the height of the water at Madison, Ind., and Louisville, Ky., with relation to stations upstream. The Kentucky River continued at a stage above 40 feet at Frankfort, Ky., for 6 days, and above 30 feet at High Bridge, Ky., for 7 days; although the upper course did not reach flood levels. The crest at Frankfort, Ky., 47.2 feet on the 25th, and 42.2 feet at High Bridge, Ky., on the 23d, are the highest ever known at those stations.

A third interesting feature was the effect of the enormous expansion of the river in the upper 5 feet on the relations with upstream gages. At the crest the river and its backwater at Louisville were 20 to 25 miles wide. This tremendous spread for a few feet of rise used up great quantities of water from up river, and reduced to a marked degree the percentage of stage increase. This was expected and partly provided for in the final estimates, but some allowance was made for a slightly higher stage than this expansion would indicate, so that no one would be caught by a crest set too low. It is estimated that this expansion reduced the probable crest at Louisville by 1.5 feet, if the usual gage relations had held.

In the last phase of the flood the river began to overflow its upper flood plain. Along the Ohio River in this district there are often two well defined flood plains, an upper on which the cities are built and a lower occupied by farm lands. At Louisville, Ky., Jeffersonville, Ind., and New Albany, Ind., these two plains merge more or less gradually into one another. At the crest the lower flood plain was covered, and only the tops of terraces on the upper plain were out of the water. Six more feet of water would have left very little of the upper flood plain protruding in the region of the three Falls Cities.

Strong currents seeking old channels across the flood plain developed in the upper levels of the flood. One of these ran down Broadway, Louisville, with such force that a boat could not be held against it. Another through the heart of Jeffersonville, Ind.,

caused much damage by battering buildings with drift. Erosion that was quite serious in places resulted from these currents. Some high building lots with a gravel base in Howard Park, a suburb of Jeffersonville, Ind., and also the Pennsylvania fill in the rear of the Colgate plant, were eroded away. The river did not run at such levels long enough to cut new channels.

Louisville was flooded to the extent of about 70 percent, and about 175,000 people were evacuated. Jeffersonville, Ind., was 90 percent flooded, and 13,000 people were forced from their homes. Several thousand people took refuge in Fort Fulton, Ind., an eastern suburb, located on a terrace with a few squares out of water. The water was 4 feet deep in the Quartermaster's Depot, which was at first a refuge but later had to be abandoned. New Albany, Ind., was about half covered, West Point, Ky., was nearly all destroyed. Leavenworth, Ind., was partly washed away. Hawesville, Ky.; Cloverport, Ky.; Cannellton, Ind.; and Tell City, Ind., were almost completely inundated.

In the latter part of the second phase of the flood, the regular telegraph and telephone communications with the section of the district below Louisville broke down. While receiving sets in that section continued to work, they obtained advice through WHAS and WAVE, the local radio stations. Crystal sets and battery sets were called into use when the electric power gave out. Amateur stations in Jeffersonville, Ind., were of service after that city had been surrounded by water and mostly overflowed. The local radio stations cooperated faithfully until driven off the air by the failure of the riverside plant of the Louisville Gas & Electric Co. at 11:35 p. m., Sunday, January 24.

At WHAS emergency power was obtained after a short interval, from the line to Dix Dam, and the service went on until the end. At the last this valuable assistant was the only agency through which this office could hope to reach the lower portion of the district. Too much cannot be said in commendation of the personnel of the radio stations, who worked to exhaustion in their efforts to broadcast flood information, calls for assistance, names of refugees, etc.

Upper gage estimates for Louisville, broadcast by radio, served well for all sections below to Tell City, Ind., when the reports from the dams could not be obtained. The people of that section have long been accustomed to the use of the upper gage at Louisville as a guide in estimating their own local flood conditions. The broadcasting of the hourly readings and estimates in terms of the upper gage gave them the information with which they were most familiar.

In the final stage of the flood, when Louisville was two-thirds under water, newspapers could not be published in the city from lack of power. Cards, carrying the forecasts and river stage, were tied to lamp posts by members of the Weather Bureau force, aided by Boy Scouts, on the island that constituted the heart of Louisville. This service continued until the Post Office again began to function. For several days the Federal Building, in which the Post Office is located, was surrounded by water. The Washington Building, in which the Weather Bureau Office is located, happens to be on one of the high spots in downtown Louisville. It is also within a few doors of the Western Union telegraph office. The "life line" of communication through the Western Union held during the flood, enabling the Weather Bureau to keep functioning. The Western Union maintained its service by moving the transformers from the basement to the upper floor and installing tractor engines to produce power. All basements contained water, and were usually one-half to two-thirds full. Fires could not be maintained except by heavy pumping, which had a tendency to carry the sand from under the floors of buildings, allowing them to collapse. For this reason, the pumps had to be stopped in places. One of the dramatic features of the flood was the continual beat of the pumps, going night and day, in the futile attempt to keep the water out of basements. At the Weather Bureau Office heat, light, power, water, and elevator service failed. These were not fully restored until February 18.

The Western Union sent a mobile unit to Jeffersonville, Ind., very quickly after communication with that place was cut off. Through Indianapolis and Cincinnati the operators of this unit were able to obtain the river stages and forecasts throughout the final stages of the flood. This unit was also able to supply New Albany, Ind., with flood information. The work of this unit was extremely valuable in preventing panic in those two cities.

When the water reached the telephone cables in the basement of the Washington Building, cutting off the Weather Bureau Office from the outside, the telephone company ran a special line in a few hours and restored service. Therefore, it was only for a few hours that this office could not be reached by telephone. During that time messenger service was used.

River stages and flood information was obtained early in the morning by teletype. The Weather Bureau men along the river strove in every way possible to get the vital information to each other.